

REMARKS

This application has been amended. In particular, claim 3 has been amended to indicate that the claim is directed to a method of manufacturing an actuator element formed of a laminate. Support for this amendment can be found throughout the specification as filed, such as on page 28. In addition, claim 3 has been amended to define the double layer capacitance value of the laminate. Support for this amendment can be found on pages 25 and 26 of the specification as filed. The other changes to claim 3 are supported by original claim 3 as well as the specification as filed. Thus, no new matter has been added. Claims 4-6, 13-14, 17 and 21 have been amended to reflect the changes to claim 3. Claims 1-2, 7-8, 16, 18-20 and 22-23 have been cancelled. Thus, claims 3, 4-6, 13-14, 17 and 21 are pending, of which claim 3 is in independent form. For the following reasons, Applicants submit that the pending claims are patentable over the cited art of record and the application is in condition for allowance.

Rejections Under 35 U.S.C. §112

Claims 22 and 23 stand rejected under 35 U.S.C. §112, second paragraph for indefiniteness. Because these claims have been cancelled, this rejection is considered moot.

Rejections Under 35 U.S.C. §103(a)

Claims 1-5, 7, 8, 13, and 16-23 stand rejected under 35 U.S.C. §103(a) for obviousness over U.S. Patent No. 4,959,132 to Fedkiw, Jr. in view of the admitted state of the prior art. Claims 6 and 14 stand rejected under 35 U.S.C. §103(a) for obviousness over Fedkiw Jr. in view of the admitted state of the art and further in view of U.S. Patent No. 5,024,858 to Burch. These rejections are respectfully traversed.

Claim 3 is directed to a method for manufacturing an actuator element formed of a laminate comprising a metal layer and a polymer electrolyte. The method includes applying electroless plating to a polymer electrolyte, and the method contains both a pre-treatment step that is carried out prior to applying plating to the polymer electrolyte and, after the pre-treatment step, an electroless plating step comprising an adsorption step and a reduction step.

The pre-treatment step is carried out in order to “reform” the polymer electrolyte. Specifically, by swelling the polymer electrolyte the crystallinity of the polymer electrolyte is reduced, alleviating entanglement of the side chains and increasing the degree of freedom of segmental movement of the side chains. One advantage that has been found by increasing the degree of freedom of the segmental movement through the pre-treatment step is that the metal complex can be adsorbed deeper into the polymer electrolyte when the metal complex is adsorbed after the pre-treatment step. As defined in the claims, the resulting laminate has an electric double-layer capacitance of 3 mF/cm^2 or more when a thickness of the laminate is converted to $170 \text{ }\mu\text{m}$.

On the other hand, the adsorbing step is not performed after the pre-treatment step in Fedkiw Jr., and thus the effect of the present invention, including the degree of swelling, is not obtained. Instead, Fedkiw Jr. is directed to a two-step process where the first step is an impregnation process in which a solid polymer electrolyte membrane is impregnated with an ionic salt or salts of the desired metal such as through the saturation of the membrane with a cationic metal salt solution and the second step is a reduction step in which an electrocatalytic film is formed on one face of the membrane. Even considering that Fedkiw Jr. teaches multiple impregnation steps, there is nothing to suggest that any of these impregnation steps constitutes a pre-treatment step or that the degree of swelling outlined in the claim is achieved.

Therefore, the rejection based on Fedkiw Jr. in view of the admitted state of the art should be reconsidered and withdrawn.

Claims 1-8, 13, 14 and 16-23 stand rejected under 35 U.S.C. §103(a) for obviousness over the admitted state of the art in view of U.S. Patent No. 5,731,104 to Ventura et al. and U.S. Patent No. 4,820,553 to Sopchak et al. This rejection is respectfully traversed.

Ventura appears to be cited as suggesting that solid polymer electrolytes can be made from polyesters or other resins. Ventura does not appear to be directed to electroless plating or pre-treating polymer electrolytes by swelling the polymer electrolyte.

Sopchak is directed to a process for conditioning the surface for polyesters and polyamides for electroless plating. The conditioning in Sopchak appears to primarily concern etching the skin layer on the surface of the polyester or polyamide. (*See* Sopchak, col. 2, line 55:

“One unique advantage of the etch process of this invention...” Sopchak does not teach or suggest swelling the polyester or polyamide so that its thickness is 130% that of the thickness in the dry state. Even if Sopchak suggests that some swelling may occur, the present invention relates to a degree of swelling of 30% or more compared to the dry state. The amount of swelling is a significant advantage of the present invention and achieving this degree of swelling is not inherent in any process in which a polymer is immersed in a solution. For example, the use of water as the swelling solution was found to achieve only a 5% swelling amount in the Comparative Examples of the subject application. Sopchak fails to provide any suggestion as to an amount of swelling that is desirable or how to achieve that particular level of swelling. Sopchak is instead concerned with achieving a desirable surface etching, and thus it cannot be presumed that one skilled in the art would find it obvious to optimize the degree of swelling in view of Sopchak. Instead, one skilled in the art would optimize exposure time, exposure temperature, etc., to reach the desired etching effect. (Sopchak, col. 5, lines 51-65.)

In addition, Sopchak includes only a description regarding polymers, and does not discuss polymer electrolytes. Combining Sopchak, which is directed to plating of polymers, with Ventura, which is not concerned with plating, on the assumption that one skilled in the art would find it obvious to reform the polymer of Sopchak into a polymer electrolyte like in Ventura is beyond the scope of what is taught in the art.

Therefore, the rejection of claims 1-8, 13, 14 and 16-23 under 35 U.S.C. §103(a) for obviousness over the admitted state-of-the-art in view of Ventura and Sopchak should be reconsidered and withdrawn.

Claims 1-8, 13, 14 and 16-23 stand rejected under 35 U.S.C. §103(a) for obviousness over the admitted state-of-the-art in view of Ventura and U.S. Patent No. 3,650,803 to Lin. This rejection is respectfully traversed.

Ventura is discussed above. Lin is directed to a process which includes forming a metal-phosphorus coating at the surface of a substrate to render the surface susceptible to conventional electroless plating. (Lin, column 1, lines 33-36.) Thus, Lin, like Sopchak, is concerned with reformulating the surface of the polymer substrate. The phosphorus surface coating is usually applied in a solvent, including solvents that are said to “swell a plastic surface

or penetrate below the surface.” (Lin, column 4, lines 39-43.) However, as with Sopchak, Lin does not speak to an appropriate swelling amount, much less a swelling amount of 30% or more compared to the dry state of the polymer. As explained above, the degree of swelling is a key aspect of the invention. Water was known to achieve swelling, though Applicants have discovered that a more significant degree of swelling is appropriate, and this has led to the development of the claimed method. Lin does not suggest achieving the at least 30% degree of swelling defined in Applicants’ claims.

In addition, the anticipated uses of the plated substrates described in column 1 of Lin suggest that the plated substrates described therein are not particularly deformable or bendable and would not be appropriate for use as an actuator. Thus, Lin is not directed to a method of manufacturing an actuator, nor would one skilled in the art concerned with manufacturing an actuator consider the teachings in Lin particularly relevant. Furthermore, combining Ventura and Lin would not be an obvious combination of the art.

Therefore, the rejection under 35 U.S.C. §103(a) for obviousness over the admitted state of the art in view of Ventura and Lin should be reconsidered and withdrawn.

CONCLUSION

For the foregoing reasons, Applicants submit that the pending claims are patentable over the cited art of record and are in condition for allowance. Accordingly, reconsideration of the outstanding rejections and allowance of pending claims 3, 4-6, 13-14, 17 and 21 are respectfully requested.

Respectfully submitted,

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